



**[4910-13]**

**DEPARTMENT OF TRANSPORTATION**

**Federal Aviation Administration**

**14 CFR Part 25**

**[Docket No. FAA-2012-1211; Special Conditions No. 25-486-SC]**

**Special Conditions:** Embraer S.A., Model EMB-550 Airplanes; Flight Envelope Protection: Pitch and Roll Limiting Functions.

**AGENCY:** Federal Aviation Administration (FAA), DOT.

**ACTION:** Final special conditions.

**SUMMARY:** These special conditions are issued for the Embraer S.A. Model EMB-550 airplane. This airplane will have a novel or unusual design feature associated with pitch and roll limiting functions, specifically an electronic flight control system which contains fly-by-wire control laws, including envelope protections. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. These special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

**EFFECTIVE DATE:** [Insert date 30 days after date of publication in the *Federal Register*].

**FOR FURTHER INFORMATION CONTACT:** Joe Jacobsen, FAA, Airplane and Flight Crew Interface Branch, ANM-111, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue SW., Renton, Washington, 98057-3356; telephone 425-227-2011; facsimile 425-227-1149.

## **SUPPLEMENTARY INFORMATION:**

### **Background**

On May 14, 2009, Embraer S.A. applied for a type certificate for their new Model EMB-550 airplane. The Model EMB-550 airplane is the first of a new family of jet airplanes designed for corporate flight, fractional, charter, and private owner operations. The aircraft has a conventional configuration with a low wing and T-tail empennage. The primary structure is metal with composite empennage and control surfaces. The Model EMB-550 airplane is designed for 8 passengers, with a maximum of 12 passengers. It is equipped with two Honeywell HTF7500-E medium bypass ratio turbofan engines mounted on aft fuselage pylons. Each engine produces approximately 6,540 pounds of thrust for normal takeoff. The primary flight controls consist of hydraulically powered fly-by-wire elevators, aileron and rudder, controlled by the pilot or copilot sidestick.

The airworthiness standards in Title 14, Code of Federal Regulations (14 CFR) part 25 do not specifically relate to flight characteristics associated with fixed attitude limits. Embraer S.A. will implement pitch and roll attitude protection functions through the normal modes of the electronic flight control system that will provide speed stability for high and low pitch angles. These functions also provide strong spiral stability for roll angles at high bank angles. In addition, bank angle limiting is introduced at speeds greater than  $V_{MO}/M_{MO}$ , up to  $V_{DF}/M_{DF}$ .

### **Type Certification Basis**

Under the provisions of 14 CFR 21.17, Embraer S.A. must show that the Model EMB-550 airplane meets the applicable provisions of part 25, as amended by Amendments 25-1 through 25-127 thereto.

If the Administrator finds that the applicable airworthiness regulations (i.e., 14 CFR part 25) do not contain adequate or appropriate safety standards for the Model EMB-550 airplane because of a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16.

Special conditions are initially applicable to the model for which they are issued. Should the type certificate for that model be amended later to include any other model that incorporates the same or similar novel or unusual design feature, the special conditions would also apply to the other model under § 21.101.

In addition to the applicable airworthiness regulations and special conditions, the Model EMB-550 airplane must comply with the fuel vent and exhaust emission requirements of 14 CFR part 34 and the noise certification requirements of 14 CFR part 36 and the FAA must issue a finding of regulatory adequacy under section 611 of Public Law 92-574, the “Noise Control Act of 1972.”

The FAA issues special conditions, as defined in 14 CFR 11.19, in accordance with § 11.38, and they become part of the type-certification basis under § 21.17(a)(2).

### **Novel or Unusual Design Features**

The Model EMB-550 airplane will incorporate the following novel or unusual design feature: an electronic flight control system which contains fly-by-wire control laws, including envelope protections, which were not envisioned when part 25 was written.

### **Discussion**

We expect that high thrust-to-weight ratios will provide the most critical cases for the positive pitch limit. A margin in pitch control must be available to enable speed control in maneuvers such as climb after takeoff and balked landing climb. The pitch limit must not impede

likely maneuvering made necessary by collision avoidance efforts. A negative pitch limit must similarly not interfere with collision avoidance capability or with attaining and maintaining speeds near  $V_{MO}/M_{MO}$  for emergency descent.

Spiral stability must not restrict attaining roll angles up to 65 degrees (i.e., an approximately 2.4g-level turn). This force must not require excessive pilot strength as stated in § 25.143(f).

These special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

## **Discussion of Comments**

Notice of proposed special conditions No. 25-12-10-SC for the Embraer S.A. Model EMB-550 airplanes was published in the *Federal Register* on November 20, 2012 (77 FR 69569). We received one comment from Mr. Sokolow, who stated that these types of rules should be generic and not pertain to one model. He said that it splinters the regulations and can lead to abuse.

We acknowledge Mr. Sokolow's concerns about issuing regulations for individual models. In the case of new technology or new designs that are not covered in the regulations, the FAA issues special conditions that are applicable to only one model of airplane. The Embraer S.A. Model EMB-550 airplane will have a novel or unusual design feature associated with pitch and roll limiting functions, specifically an electronic flight control system which contains fly-by-wire control laws, including envelope protections. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. These special

conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

We agree with the commenter that the FAA should issue general rulemaking to cover general issues that affect many types of airplanes. Currently, the FAA is tasking an Aviation Rulemaking Advisory Committee (ARAC) to address this and other similar requirements for electronic flight control systems (EFCS). The goal is to develop general rules that could be applied to all designs. In the meantime, however, we will continue to issue special conditions to ensure an adequate level of safety for specific EFCS design features.

We are adopting the special conditions as proposed.

### **Applicability**

As discussed above, these special conditions are applicable to the Model EMB-550 airplane. Should Embraer S.A. apply at a later date for a change to the type certificate to include another model incorporating the same novel or unusual design feature, the special conditions would apply to that model as well.

### **Conclusion**

This action affects only certain novel or unusual design features on one model of airplanes. It is not a rule of general applicability.

### **List of Subjects in 14 CFR Part 25**

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

The authority citation for these special conditions is as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701, 44702, 44704.

## **The Special Conditions**

Accordingly, pursuant to the authority delegated to me by the Administrator, the following special conditions are issued as part of the type certification basis for Embraer S.A. Model EMB-550 airplanes.

In addition to § 25.143, the following requirements apply:

1. Flight Envelope Protection: Pitch and Roll Limiting Functions.

a. The pitch limiting function must not impede normal maneuvering for pitch angles up to the maximum required for normal maneuvering, including a normal all-engines operating takeoff, plus a suitable margin to allow for satisfactory speed control.

b. The pitch and roll limiting functions must not restrict or prevent attaining pitch attitudes necessary for emergency maneuvering or roll angles up to 66 degrees with flaps up, or 60 degrees with flaps down. Spiral stability, which is introduced above 33 degrees roll angle, must not require excessive pilot strength to achieve these roll angles. Other protections, which further limit the roll capability under certain extreme angle of attack or attitude or high speed conditions, are acceptable, as long as they allow at least 45 degrees of roll capability.

c. A lower limit of roll is acceptable beyond the overspeed warning if it is possible to recover the aircraft to the normal flight envelope without undue difficulty or delay.

Issued in Renton, Washington, on February 26, 2013.

Ali Bahrami  
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Aircraft Certification Service